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NEW LIGHTING FOR OLD BUILDINGS*

By

E. H. PENWARDEN, N.R.D. *(Member)*, and S. ANDERSON, B.Sc. *(Member)*

SUMMARY

Some reasons for the improvement of artificial lighting in old buildings are discussed, and in addition to the desire to secure direct improvement of vision and to reveal the interior architecture and decoration, the provision of a more cheerful and comfortable appearance, the improvement of colour rendering and the desire for illumination comparable with that found in more modern buildings are covered.

Present lighting technique is reviewed and the characteristics of contemporary electric light sources and their bearing on the subject of the paper are discussed. Factors involved in light control are dealt with and the effect of different methods of lighting on the revealing of form, texture and colour are illustrated.

The variety of buildings considered is limited to those employed for historic, civic, official and domestic purposes, and some consideration is given to the architectural styles encountered. A broad classification into (a) buildings of historic style and tradition requiring improved lighting, and (b) buildings whose use dictates the adoption of a modern standard of illumination, is made, and the implications of each requirement outlined.

The co-ordination of the requirements of the architect and of the illuminating engineer is considered, and various practical methods of dealing with the problems involved are suggested. Actual and theoretical examples of the application of new light sources, together with the design of the lighting fixtures and the disposition of the control gear, are given and illustrated.

1. Introduction

Modern standards of illumination have advanced to such an extent that the public are becoming more and more critical of the subdued lighting that for years has been accepted as adequate in many buildings of historic interest. In public buildings of more recent origin the values of illumination were up to recognised practice in their day, but they fall far short of the intensities which are considered adequate to meet modern requirements.

Much has already been done in the industrial field to rectify this state of affairs, and fluorescent lighting units in their thousands have been successfully applied, but when aesthetic considerations have to be taken into account the application of scientific lighting principles has to be co-ordinated with architectural and decorative requirements. In these conditions, the shape and size of the light source and the quality of the light play an important part.

The scope of this paper is limited to a consideration of some of the architectural aspects of installing new lighting in old buildings, making use of the most suitable light sources. First, it will be appropriate to review the reasons

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why improvement is desirable, and to discuss modern lighting technique, much of which has been devoloped since the original lighting was installed.

Light Distribution for Vision

With old installations one frequently finds wide variations exist in the illumination provided from point to point in an individual room, the whole of which is devoted to a given purpose. While such variations may often be tolerable and even desirable with daylight in which the minimum illumination may well be in the region of 100 L/sq. ft., in the case of artificial light the order of intensities is so much lower that a wide variation gives rise to an objectionable difference in facility of vision from place to place.

The existence of these variations, and the protests of those who experience them, are frequently made evident by the presence of supplementary lighting in the form of additional and often incongruous pendants, table lamps, or bracket lights. Reference is made later to various forms of supplementary lighting which may be employed without detracting from the appearance of an old building. Here it will suffice to point out that ill-conceived supplementary lights, usually chosen with great regard to economy in initial cost, but little to fitness of form, do much to spoil the appearance of a fine interior. Small variations are imperceptible to the eye, but experience suggests that large variations should be avoided, and within the area where visual tasks may have to be done a ratio of maximum to minimum illumination of 1½ to 1 has been quoted as the maximum diversity which should be accepted.

Better Illumination for Comfort and Cheerfulness

In public buildings which are consistently used for a specific purpose, such as churches or assembly halls, relatively uniform illumination adds materially to comfort and cheerfulness. It must be within the experience of most of us to have seen the seating accommodation of an interior very unevenly occupied. In many instances it can be directly attributed to a high diversity of illumination.

Better Light Distribution for Revealing Beauty

The architectural features of many historic buildings have for generations been concealed in gloom, especially those that are mainly used under artificial light. A percentage of upward illumination is desirable; the amount necessary varies with the height of the ceiling and its decorative treatment. In cases where the ceiling is not unduly high and has a reasonably good reflection factor, it can be effectively used to improve the distribution of the direct light from the fittings and reveal the architectural features to better advantage.

A lofty ceiling with dark roof trusses and beams is of little value as a lighting asset, but the addition of upward light enhances the appearance of the interior and dispels the tunnel effect produced by the strong brightness contrast when the ceiling is unilluminated.

Better Rendering of Colour Values

Where the old installation employed lamps of low wattage, improved colour rendering is obtainable by a change to suitably accommodated lamps of larger sizes, but improvement to a far greater degree is achieved by the use of fluorescent lamps, in which the colour of the light is dependent not on temperature but on the composition of the fluorescent coating of the lamp. With the fluorescent lamps at present available, colour rendering and appearance much closer to daylight than that obtainable from any other type of lamp is achieved. Still further improvement is not improbable, and there

is little doubt that in the fluorescent lamp we have for the first time the possibility of both colour rendering and source colour which are comparable with natural light.

In addition to the colour composition of the light from the lamp, at least three other factors have a bearing on colour rendering. The lighting fitting may modify the colour of the light by selective absorption. Such modification has been employed in fittings for filament lamps with a view to reducing the preponderance of red and yellow in their light. A reasonable measure of colour correction by this means involves the absorption of at least 50 per cent. of the bare lamp light. It is therefore an uneconomical proposition and seldom employed except for the local illumination of a small area.

It will be appreciated that colour modification obtained by these means is subtractive. A colour which is absent from the spectrum of the incident light cannot be added by a reflecting or transmitting medium.

The same characteristics apply to reflection from walls and ceiling. Thus the importance of the finishing colours of the interior decoration in securing or retaining good colour rendering increases with the proportion of the light from the fittings reaching the working plane from walls and ceiling. For totally indirect lighting, the colour control exercised by the decoration is complete. For totally direct lighting, the ceiling colour is immaterial, and it is only in regions close to the walls that the colour of these has any effect on the illumination. In the normal intermediate conditions, a measure of colour-control exists.

The third factor in securing good colour rendering is the level of illumination. Where colour rendering is critical, experience has shown that a high level of illumination is essential, and this is equally true whether the lighting is natural or artificial.

Economy

Apart from a slight increase during the recent war, the cost of artificial light per lumen-hour has been progressively reduced over many years. Thus in buildings where the lighting installation is an old one, the amount of light provided is often more in accord with the economies obtaining when it was planned than with those of the present time. Not only do present day standards demand more effective illumination, but the present lower cost of electricity and of lamps renders it possible to provide a higher standard economically.

The economy of new lighting for old buildings is not, however, based only upon these factors. Due to improved technique and to the availability of improved materials for light control, more efficient use can now be made of the light generated by the lamp. Much of the advance made in the efficiency of filament lamps has already been secured without alteration to old lighting installations, but the increase in efficiency obtainable by the use of fluorescent lamps, which give 2½ to 3 times the light output of equivalent wattage filament lamps, can only be secured by new lighting installations. Their dimensions, and the necessary auxiliary gear, usually prohibit their use in old fittings.

While lighting is only one of the many services with which the architect is concerned, it must be regarded as an important item, for it must be relied upon for the appreciation of form and decoration and it is essential to whatever use the building may be put. Due economy is usually necessary in the interest of the owner, but it is neither in the best interest of the owner nor the architect that lighting should be treated parsimoniously, for a poorly conceived and executed lighting installation may well mar the appearance

of an otherwise fine interior, both by day and by night. The form and pattern of the lighting fittings is generally evident in daylight, even though their effectiveness is only seen after dark.

The attitude is still encountered that since the number of hours per annum during which artificial light is required is small compared with the hours of daylight, the importance of the artificial lighting is proportionately small. It is contended that there are a great many cases in which this conclusion is mistaken; for it is not uncommon for the principal use of an old building to be concerned with meetings and other functions of a civic, recreational or social nature which take place after normal business hours, and almost entirely during the darker period of the year. Thus while the use of the artificial lighting may be only some 100-200 hours per annum, this particular period may represent a very high proportion of the total time the room in question is in use.

2. Present Lighting Technique

In many cases the lighting in old buildings was limited more by what was then known and available than by any intentional "skimping the job." In both form and workmanship the lighting fittings were worthy of the interiors for which they were made, but they were designed to take lamps of small size and low output, to incorporate glass which was either clear or of poor transmission, when curved mirror reflectors were almost unknown, and when electric lighting was following somewhat blindly along the lines which experience had shown to be suitable for candles, oil or gas lamps.

Now lamps of greatly increased light output, of more convenient form and of high efficiency are available. Media permitting accurate control and great diffusion with high transmission have been produced. Almost anything is possible, and the illumination of a building is determined not by what can be obtained, but by what is considered desirable and suitable.

A consideration which is assuming increasing importance is the use of the artificial lighting system to supplement daylight. The necessity for making use of all the available space, the erection of high surrounding buildings, and the inadequacy of light wells coupled with the high proportion of dull days in this country, all militate against the adequacy of natural lighting. Thus the necessity for artificial supplementary lighting is considerable. The standard of lighting required for this purpose is high, for it must provide an intensity sufficient to bear comparison with that provided naturally in other areas of the same room. The colour of the light should preferably blend well with daylight. Formerly, these requirements were seldom if ever attained, but thanks to the high efficiency and good colour of new light sources they can now be achieved.

Relationship Between Light and Vision

Before going on to discuss more detailed matters of technique, it may be well to recall the fundamentals upon which contemporary illuminating engineering is based; principles which were far less widely appreciated formerly than they are to-day. There is no doubt that practically every visual task is performed more easily, more quickly, and with less strain with a high level of illumination than with a low one, and that the more difficult the visual task the higher the level of illumination required for maximum facility. The relationship between the illumination and the improvement in visual acuity is more nearly logarithmic than linear.

We see by contrast—contrast in brightness, in colour, and in texture. The lighting installation should bring out these contrasts by virtue of its directional

characteristics and colour qualities, as well as by the intensity of the illumination provided; yet in providing such illumination, general appearance and atmosphere must not be sacrificed.

Though its assessment is not easy, there is no doubt that one's state of mind is influenced by illumination. It is not accidental that terms such as "bright" and "gloomy" are applied both to an interior and to the personal feelings. The inhabitants of a well-lighted room are inevitably influenced by the brightness of their surroundings and the facility with which they see promotes confidence and certainty in action.

Revelation of Form, Texture and Colour

In an old building there is frequently a great deal of beauty in the textures, colour and decorative forms used. Their revelation is dependent on the lighting and it is therefore of great importance that any modernised lighting scheme should meet this requirement quite apart from its function in providing adequate illumination on the working plane.

Revelation of form or relief is obtained when the illumination is received predominantly from one direction. In some cases, such as symmetrical forms, it matters little which is the direction chosen so long as it is oblique, but in others of an asymmetric character such as statuary and other forms found in nature, the form appears distorted and often almost unrecognisable unless the light comes predominantly from above. While all lighting is directional to a degree, considerable variation in this characteristic is possible in the design of fittings. The position and mounting height of fittings are also of importance in this connection.

It is generally desirable to avoid extreme contrast in brightness between high lights and shadows otherwise any detail existing in the shadow is lost, and a harsh effect is produced. Soft shadows may be ensured by the use of well diffused general lighting with no marked directional qualities, coupled with strongly directional auxiliary lighting arranged to pick out the highlights.

Texture reacts to light in much the same way as form but with a much finer "grain." A high level of illumination is therefore necessary for the full appreciation of the detail, and the directional component in the lighting may be required at a fairly acute angle to the textured surface. In some cases the pattern on a textured surface is mainly due to differences in gloss or to the presence of a glossy pattern on a matt ground. Much of the life in such a surface is due to direct specular reflection from the glossy portions. Lighting should therefore be arranged to provide a source of suitable brightness in such a position relative to the textured surface that its direct reflected ray emerges towards the eye. Such treatment can be very effective when applied to tapestries or curtain materials which embody glossy and matt figuring. Caution is necessary, however, for the detail may be obscured by shine. In the case of pictures or materials displayed behind glass, for instance, any lighting which gives direct reflection of bright surfaces towards the eye is disastrous, and in picture galleries, therefore, the angle of the incident light must be chosen so that reflected rays are directed below eye level.

The revelation of colours in their daylight hues is dependent upon the presence of the colours in the composition of the light falling upon them. The relative proportions in which the colours are present must approximate closely to those in natural light. These requirements present a difficult problem, for natural light is very variable in composition. It varies from hour to hour and it varies according to the aspect of the sky providing the illumination.

By means of light filters consisting of carefully chosen coloured glasses, it

is possible to obtain a light of very similar composition to that of any desired type of daylight, but this method is most uneconomical as has already been indicated. It also suffers from the disadvantage that the light from the lamp as it ages becomes progressively more biased towards the red end of the spectrum.

The colour of the daylight fluorescent lamp has been chosen so that it has a quality similar to that from a sunny sky obscured by light clouds. It is not intended as an accurate colour matching light, but it gives a natural appearance to an interior, particularly when the general intensity of light is high.

The warm white fluorescent lamp, on the other hand, makes no pretence of imitating any kind of daylight. It gives a light which is pleasingly warm and mellow in tone and which bridges the wide gap between the over-red filament lamp light and the much colder light from the daylight fluorescent lamp.

Characteristics of Contemporary Electric Light Sources

(a) *Tungsten Filament Lamps.*

At the present time a great deal of attention is being given to fluorescent lamps. Their popularity is indicated both by the number of fluorescent lighting installations which can be seen, and by the great demand which exists for them, a demand which is at present far in excess of the capacity of the manufacturers to meet. It is felt, however, that there are very many cases in which the relighting of old buildings can be accomplished equally well by means of filament lamps, and a considerable number in which the use of these lamps is definitely preferable. A summary of the more important characteristics of tungsten filament lamps is therefore appropriate.

The lamps at present available embody improvements which have been made as the result of over half a century of research work and practical experience. The most recent improvements have resulted in increased light output for a given wattage.

In general, filament lamps are designed to give best service when they are used vertically with the cap uppermost. In this position the blackening of the glass, due to filament evaporation, takes place principally in the neck of the bulb where it interferes but little with the output of light. In this position also the filament is supported most advantageously. The cap-up position does, however, give rise to a high cap temperature, and with the higher wattage lamps it is desirable to allow for adequate cooling of the lampholder which should have contacts and connections suited to the temperatures attained.

Certain lamps are made for cap-down or cap-horizontal burning, and these are especially suitable for use in fittings in which it is desired to avoid having lampholders and connections appearing above the light centre, for example in shallow bowl-like fittings and in mirror reflectors for indirect lighting. Some sacrifice in lumen maintenance, efficiency or life is usually inevitable, but this is not so marked as it is when general service lamps of the same wattage are burned in a similar position.

Linear striplite and architectural lamps employing extended filaments are less efficient than general service lamps of equivalent wattage. Their use can only be justified by their effectiveness in a particular location. The longer architectural lamps are far outstripped in performance by the 5 ft. and 4 ft. fluorescent lamps, and the position with the shorter linear filament lamps will be similar when corresponding lengths of fluorescent lamps are available.

The brightness of the filament in a gasfilled lamp is of the order of 2,000 candles per square inch, and while the internally frosted "pearl" bulb reduces the maximum visible brightness to about 100 candles per square inch, even

a brightness of this order near the direction of vision is too great to be comfortable in normal conditions. While a maximum visible brightness of five candles per square inch may be permissible for luminous surfaces within 20 degrees above the horizontal at eye level, a lower value of the order of one to two candles per square inch is preferable. Thus for this reason alone some form of shading or light control is essential with general service and most other filament lamps. Due to their relatively small dimensions, filament lamps lend themselves well to precise light control by refraction or reflection, and they can be accommodated in diffusing fittings of small size which are both convenient and economical.

(b) *Fluorescent Lamps*

Much of the development work on fluorescent lamps was carried out in England before the war, but for which they would have been placed upon the market in this country at about the same time as they were introduced in the United States. Production in this country was strictly limited to meet essential war-time needs until the end of 1944. Thus experience of their general use in this country is virtually limited to the post-war period.

In the fluorescent lamp, ninety per cent. of the visible light is due to the fluorescence of the powder on the inner surface of the glass tube. This powder or phosphor is energised by ultra-violet radiation generated by the electric discharge through the low pressure mercury vapour contained in the tube. The remaining ten per cent. of the light emitted by the lamp comes directly from the electric discharge.

The colour of the light is determined by the composition of the phosphor used. At the present time both daylight and warm white lamps have the same efficiency, but it does not follow that this will always be the case, for the phosphors are different in chemical composition and improvement in one may not to be applicable to the other. Where lamps are employed in pairs or closely spaced, a pleasing blend of light intermediate in colour between the two is obtained by employing one daylight and one warm white lamp.

Efficiency figures quoted by the manufacturers for fluorescent lamps are related only to the power absorbed in the lamps, and do not take account of the small losses in the associated gear. These constitute between ten and twenty-five per cent. of the lamp wattage, but even so the overall efficiency of lamp and auxiliary gear remains very favourable.

When first put into service, fluorescent lamps give appreciably more light than their rated output, which is based on the average value during a normal life. The fall off is relatively rapid during the first one hundred burning hours, after which the deterioration is quite small.

Fluorescent lamps are at present made in 5 ft. and 4 ft. lengths, the former rated at eighty watts and the latter at forty watts. Thus in spite of their large physical size and high efficiency, they are essentially light sources of limited output, and in many cases multi-lamp fittings are necessary to achieve modern standards of illumination without using an excessive number of fittings. Owing to their low surface brightness there are some situations in which fluorescent lamps may be used without shades or diffusing media.

The life of fluorescent lamps is rated at three thousand hours for the eighty watt and two thousand five hundred for the forty watt size; thus where re-lamping presents difficulties they are preferable to tungsten filament lamps.

Several factors influence the disposition of the auxiliaries which are necessary with fluorescent lamps. Since each lamp must have its own individual starter and choke, it is economical to arrange for these to be placed close to

the lamp, but where there is no convenient position available, the choke may be placed elsewhere, and there is no limit to the permissible length of the intervening wiring. Where a considerable number of lamps is involved, the provision of separate feeds to each from a remote choke position becomes cumbersome and expensive.

The starter is small and it is seldom that there is any difficulty in housing it close to the lamp. If it were to be situated remotely, two additional wires would be required from each lamp, and it would be desirable to fit separate small interference suppression capacitors.

While originally only a cubic shape of choke was made, a second type, of long slim proportions is now available, and this lends itself admirably to housing in many convenient spaces where it was not possible to accommodate the earlier cubic shape. Power factor correction capacitors are now also made with similar slim proportions, and it is usually possible to accommodate these near the chokes.

Chokes in operation generate a small amount of heat, and it is therefore necessary to allow an air circulation space round them. Ventilation of the choke housing is desirable where a number of chokes are housed together, but single chokes may be used in unventilated enclosures provided that the ambient temperature is not abnormal. When a number of chokes are housed together a free airspace should be allowed round each.

Capacitors generate practically no heat, and may therefore be packed close together, but they should preferably not be situated in a position where the ambient temperature may exceed some 40 degrees C. (100 degrees F.).

Once installed, good quality chokes and capacitors very seldom require attention and have an indefinitely long life. Easy access to these items is therefore not essential. Starters require replacement from time to time, and should be situated in accessible positions.

(c) *Cold Cathode Fluorescent Tubes*

These were introduced a few years before the war in the form of made-to-measure installations, principally in stores, restaurants and public buildings.

Cold cathode tubes are made to give daylight and warm white light using phosphors similar to those in fluorescent lamps. In addition an intermediate white is available. In each case the efficiency is comparable with that of the hot cathode fluorescent lamp. When first introduced, however, the powders to give white light from a single tube had not been perfected, and two or three complementary colours were used in adjacent tubes to give the colour desired. A considerable number of these coloured phosphors were developed in shades of green, blue, gold and pink and, by mixing these together with a clear neon-filled tube giving red light it is possible to obtain a very wide range in the quality of the resultant light.

The luminous efficiency of an installation of coloured tubes is generally somewhat lower than that of the white tubes, but novel and interesting effects are obtainable, particularly when individual colour dimming is employed, and the tubes are concealed in such a way that the resultant effect only is visible.

Short tubes of the cold cathode type are inefficient because there is a considerable dissipation of power at the electrodes, and this is independent of the tube length. Thus long tubes are preferable, and in practice a maximum straight length of about ten feet is the present limit for an individual tube. The tubes can be shaped during manufacture, thus making it possible to follow a structural feature such as the curve of a barrel ceiling. It also makes it possible to provide apparently continuous lines of light by turning the tube electrodes through 90 or 180 degrees, so that the luminous portions butt up together.

Since they carry a high voltage, the tube electrodes are housed in earthed metal boxes to ensure safety. The necessary transformers are normally accommodated a short distance away from the tubes in "tailor made" installations, and one transformer supplies several lengths of tube connected in series.

Cold cathode lighting is also obtainable in standard self-contained units, each consisting of three tubes with combined electrode and transformer boxes, the whole being carried on a metal channel with an overall length of ten feet. The service light output of such a unit is rather more than five thousand lumens, or roughly equivalent to that of two two-hundred watt filament lamps, and its power consumption is approximately two hundred and forty watts.

Cold cathode tubes have an extremely long life, and this is determined more frequently by a drop in light output than by failure. A rated life of six thousand hours is quoted, but instances have been reported of tubes having served up to three times this figure still being in operation. A gradual fall-off in light output occurs, but there is not such a sharp initial fall as in the case of the hot cathode fluorescent lamps.

Methods of Light Control

Tungsten filament lamps are seldom used without some form of light control. Even when the lamps are used unmasked it is usual to install a translucent glass shade to provide a brightly illuminated background in close proximity to the lamp in order to reduce the brightness contrast between the lamp and its surroundings.

It has already been pointed out that the brightness of the filament lamp is far too high to permit its use in normal circumstances without some form of screening designed to bring the visible brightness down to a value which is comfortable when viewed against its normal background brightness. But light control is also necessary to secure the best utilisation of the light from the lamp. It is economical to provide some form of control which reinforces the light output in preferred directions at the expense of the output in less important directions. Three methods are available. They employ the optical principles of reflection, diffuse transmission and refraction.

Reflectors of silvered glass or polished metal are employed to redirect the light falling upon them into a beam or fan of light towards the plane to be illuminated. Being specular, the angular width of the beam and its direction are controlled by the contour of the reflector and its position in relation to the lamp.

Reflectors of white enamelled metal or other white opaque surfaces redirect the light falling upon them in a more or less diffuse manner according to the nature of the surface. Translucent materials, such as opal glass or plastics, transmit and diffuse a proportion of the light falling upon them, while a proportion, dependent upon the angle of incidence and the nature of the material, is reflected more or less specularly.

Refractors of transparent material such as clear glass or Perspex transmit most of the light falling upon them. The emerging light may be diffused if the figuring of the medium is irregular as in hammered or raindrop glass, or it may be more closely controlled where the medium is of regular prismatic or reeded form.

Where the whole of the lamp light is caught by the controlling medium, all

will be controlled, but where only a portion of the light is caught the remainder is uncontrolled—in practice the latter condition is the more usual.

In some cases the direct (uncontrolled) light from the lamp is used to illuminate the nearer portion of the area to be covered, while the portion which is controlled is directed towards the more distant parts of the area. The concentration thus achieved helps to equalise the illumination over the whole area.

With fluorescent lamps, the low source of brightness seriously restricts the maximum candle power obtainable from a single lamp. Where a high candle power is necessary, it may be built up by superimposing the controlled light from a number of lamps each having its own parabolic specular reflector. The sectional dimensions of parabolic trough reflectors for use with fluorescent lamps are necessarily greater than those required to give a similar measure of control with clear linear filament lamps, owing to the much greater diameter of the source in the fluorescent lamp.

Materials

(a) *Glass*

Most of the materials used as diffusing media are too well known to require detailed description. Flashed opal glass is perhaps the most widely used where a soft lighting effect is favoured.

Clear figured glass is used where some degree of diffusion without loss of vitality is required, especially where maximum efficiency is essential and directional reflectors are installed.

Ribbed glass is most effectively used with fluorescent lamps in similar circumstances.

(b) *Perspex*

Much interest has been aroused by the introduction of plastic material under the name "Perspex" for light diffusion and reflection. It can be moulded or bent into suitable forms and curves for lighting requirements and as it is not brittle it makes an excellent substitute for glass.

It is, however, subject to temperature limitations. Moulded forms are liable to distortion at temperatures above 80°C. It is safe to use with fluorescent lamps and relatively low wattage tungsten lamps, but adequate ventilation must be provided in cases where this temperature is otherwise liable to be exceeded.

There are two types of Perspex commercially available for lighting purposes, namely, "clear" and "opal." They are made in sheets of various gauges, but up to present clear Perspex is not available with a surface suitable for the diffusion of light.

Various frosted effects can be obtained by the application of lacquers and by sandblasting, and samples have also been made simulating the figuring of morocco and stipolite glasses.

Clear sheet Perspex can, however, be machined, and a reeded surface so produced is being successfully used as a sparkling diffusing medium for tungsten and fluorescent lamps.

Medium opal Perspex has a high reflection factor but a low transmission. It is extensively used in the form of moulded trough reflectors and is available in several attractive pastel colours, but owing to its low transmission factor it is not satisfactory as a light-diffusing medium.

Another diffusing type of Perspex has been experimentally produced in this country which is similar to the American plastic known as "Lucite." Having

excellent diffusing properties, very high transmission and low absorption factors, it is comparable with flashed opal glass.

Some trouble has been experienced in the use of Perspex due to the tendency to attract dust after cleaning. This attraction is apparently caused by a static electric charge being built up on the surface of the material. A number of proprietary cleaners have been marketed which claim to overcome this trouble. Very good results can, however, be obtained by cleaning with a damp cloth. It is most important to avoid polishing the surface with a dry cloth.

(c) *Anodised Aluminium*

Anodised aluminium and aluminium alloys will probably be extensively used in the construction of lighting fittings, some experience having already been obtained in the use of anodised aluminium for reflectors.

Brightened and anodised aluminium reflectors have good optical characteristics, but are limited in their usefulness by liability to atmospheric attack. In their present stage of development they are not suitable for locations where any extensive condensation or wetting may occur in the presence of corrosive agents. There is, however, no reason to expect any trouble in locations where the atmosphere is dry and does not contain a high concentration of corrosive agents.

Three grades of aluminium may be used for reflecting surfaces:—

Grade A 99.99% aluminium.
„ B 99.8% „
„ C Commercial quality aluminium.

The Grade A material, while possessing the best specular reflection properties, is at present rather more than twice the price of Grade B metal. The use of the Grade C metal should normally be restricted to diffusing or matt finishes.

The specular reflectivity varies with the grade of metal and with the anodic film thickness. Typical values of total reflection factor are given in the table. In the case of the specular materials, the specular reflection factors are very nearly equal to the total reflection factors.

Material	*Total Reflection Factor*
Specular Reflectors	
Mirror Glass	85—90%
Anodised Aluminium Grade A	80—84%
„ „ Grade B	65—75%
„ „ Grade C	60—70%
Chromium Plate	60—65%
Diffuse Reflectors	
White Plaster	80—90%
White Paint	75—85%
White Porcelain Enamel	60—89%

3. Types of Building

A great variety of achitectural styles are envisaged in the title "Old Buildings." They can be divided into two categories:—

1. Old buildings of historic interest requiring improved lighting,
2. Old buildings of later period requiring modern standards of illumination.

Old buildings of historic interest do not usually require very high intensities of illumination, but better lighting than was possible with the primitive facilities available at the time of the erection of the building.

Old buildings of later period requiring modern standards of illumination would in the majority of cases have had electric light installed when built.

Methods of treatment can be extremely varied, but the one selected should be based primarily on an effort to imagine what the original architect would have done if he had had the facilities of modern lighting equipment and a knowledge of its scientific application at his disposal.

There are many instances, however, where this is not too obvious, and in such cases it is essential to strike a balance between the requirements of the architect and of the illuminating engineer.

The architect is mainly concerned with the preservation of the architectural characteristics of the room. He therefore almost certainly imposes restrictions regarding the positioning and appearance of the structure required to house the lighting equipment, thus enforcing a measure of restraint on the illuminating engineer, but experience has proved that in general a compromise, leading to quite satisfactory results, can be found.

The functional uses of buildings vary as widely as their architectural characteristics, and the possible solutions of the lighting problems are subject to like variations. It is seldom that identical methods can be adopted in two or more buildings; some modification is usually necessary to meet local requirements.

The architect is faced with the problem of the proportions and design of the fixtures required to house the lighting equipment. At this stage may be introduced the fittings designer, whose chief responsibility is to translate the ideas of the illumination engineer and the architect into a functional unit which is both of sound mechanical construction and in aesthetic harmony with its surroundings.

There is a strong concensus of opinion that the industrial designer should be drawn from the ranks of the architectural profession. Practical manufacturing experience is, however, indispensable if designs are to be produced on a sound constructional and economical basis. Let us therefore accept the principle of triple co-ordination in discussing the broad lines of approach to the problems involved in fuller detail.

4. Methods of Treatment

The method of treatment must necessarily be governed by any limitations imposed by practical installation requirements, the two main factors being wiring and maintenance.

In old buildings of historic interest having lighting fixtures already installed which, whilst inadequate as light sources, form an integral part of the interior decorations or must be retained for traditional reasons, the obvious course is to adapt the existing fittings.

Candle fittings can usually be adapted to take the much abused electric candle fitments and the light from these may in turn be augmented by additional tungsten lamps concealed in the fitting (if it lends itself to such treatment), or, alternatively, in some structural feature either existing or provided. Such additional lighting sometimes creates the illusion that the light is coming from the old fittings. In cases where the old fittings are unsuitable for adaptation and can be dispensed with, the straightforward application of modern light sources may be successful.

The chief problem likely to present itself in historic buildings is one of

Fig. 1.

brightness contrast. The walls are usually very dark, and bright light sources silhouetted against them appear very harsh. Surfaces such as polished mahogany offer the further problem of specular reflections. A solution may be found by exploring the possibilities of indirect lighting from pendants or standards with very subdued visible luminous surfaces, or alternatively direct lighting from ceiling fixtures of appropriate design.

Buildings in which electric lighting is already installed but is of obsolete character give much wider scope for original treatment and the application of modern light sources. Much misunderstanding and dissatisfaction are sometimes

Fig. 2.

caused by the rash and thoughtless recommendation and use of innovations such as fluorescent lamps. There is nothing more likely to create prejudice against such new developments than their misapplication. Nevertheless, when careful discrimination is exercised they lend themselves to the solution of lighting problems in which the point light sources of tungsten lamps would be unsatisfactory and often uneconomical.

Such sources, with their large area and low surface brightness, lend themselves readily to linear effects and they can also be grouped together to localise the light sources. They are indispensable where colour discrimination is necessary and provide a soft and relatively shadowless effect.

On the other hand, one cannot dispense with tungsten lamps when accurate and concentrated light control is necessary, or where a concentration of illumination from light sources of limited size is required.

The type of lamp to be used for each installation must therefore be determined by local conditions. The nature of the work to be carried out in each room (e.g., clerical work, display of goods, etc.), and the varying reaction of goods displayed to the quality of light require consideration.

Of the many possible alternative methods of treatment the following are typical:—

1. Adaptation of existing fittings.
2. Design of new fittings in appropriate style.
3. Straightforward use of modern methods and equipment.
4. Supplementing existing lighting from concealed sources.
5. Fittings built into or externally applied to the structure.

The London Guildhall (Fig. 1) furnishes a practical example of the adaptation of existing fittings in an old building of historic interest. The old fittings

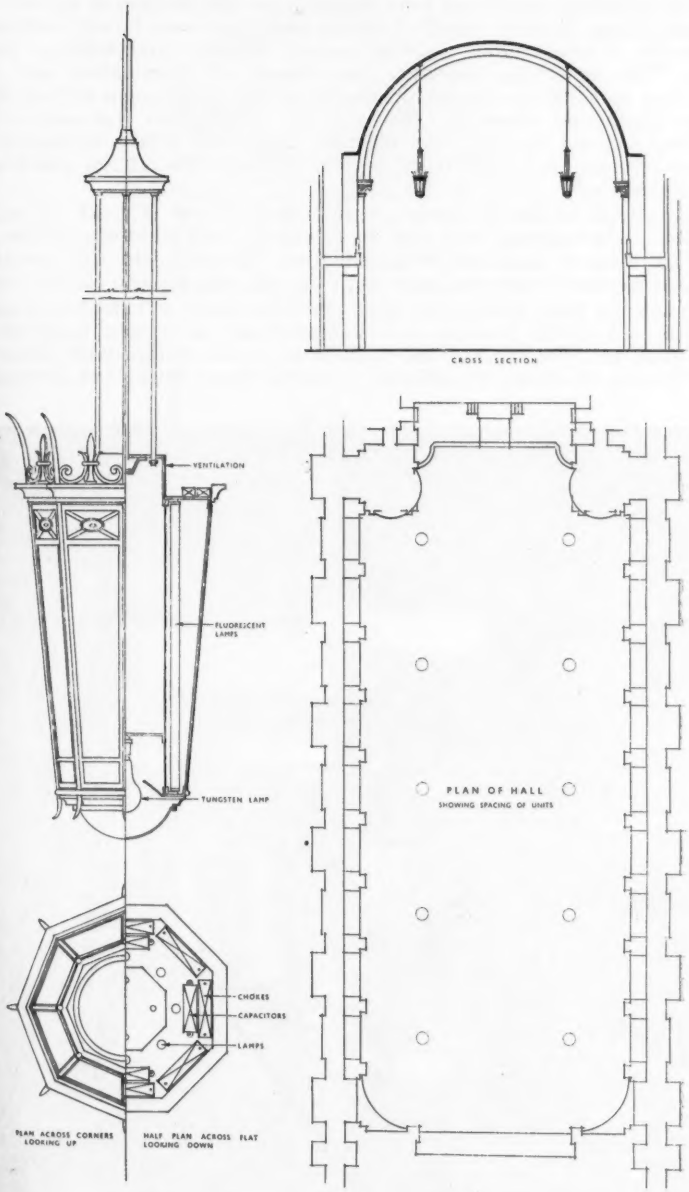
CROSS SECTION
VENTILATION
FLUORESCENT LAMPS
TUNGSTEN LAMP
CHOKES
CAPACITORS
LAMPS
PLAN ACROSS CORNERS LOOKING UP
HALF PLAN ACROSS FLAT LOOKING DOWN
PLAN OF HALL
SHOWING SPACING OF UNITS

Fig. 3.

were progressively converted from fishtail flame gas burners to electric carbon filament lamps, then to gas-filled lamps, and they were finally reconstructed to provide a semi-indirect lighting system utilising high-wattage gas-filled lamps. This materially increased the intensity of illumination and at the same time revealed the fine architectural features of the room without destroying its traditional character. The upward illumination was augmented by concealed indirect lighting from filament lamps with reflectors located in the window recesses. It is to be regretted that this beautiful interior was destroyed during the war.

In contrast to this, a restaurant in Regent Street (Fig. 2), although not actually an old building, falls into the category of old buildings of later period requiring modern standards of illumination. The wrought iron pendants as originally designed were equipped with the old type electric candle tubes.

To convert these fittings into units providing modern standards of illumination, the old candle fitments were removed and sixty watt tungsten lamps were fitted into the sockets and masked by celoid shades with flashed opal glass discs at the base. In addition, a glazed centre fitting was designed and

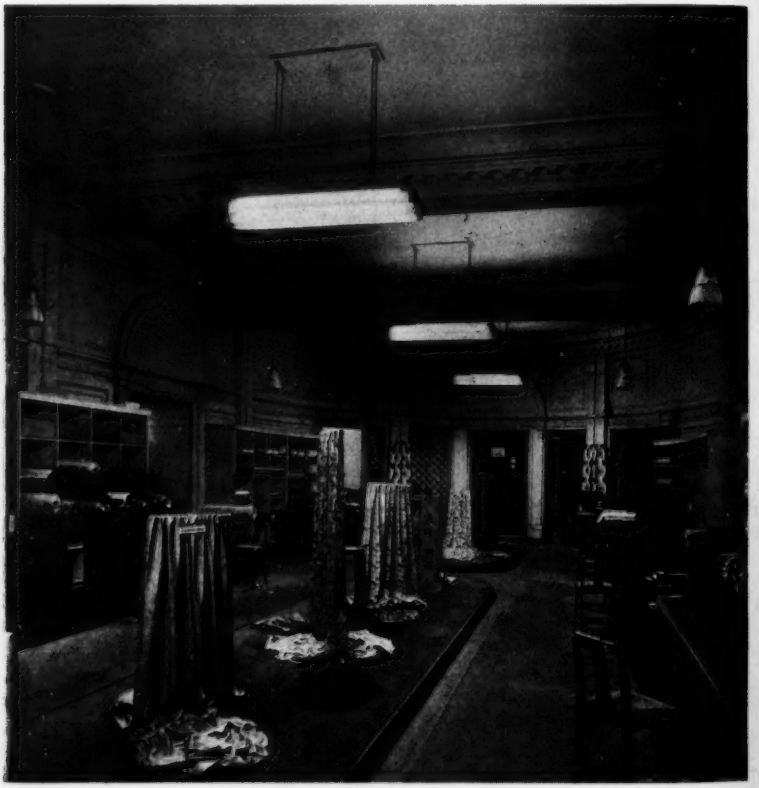

Fig. 4.

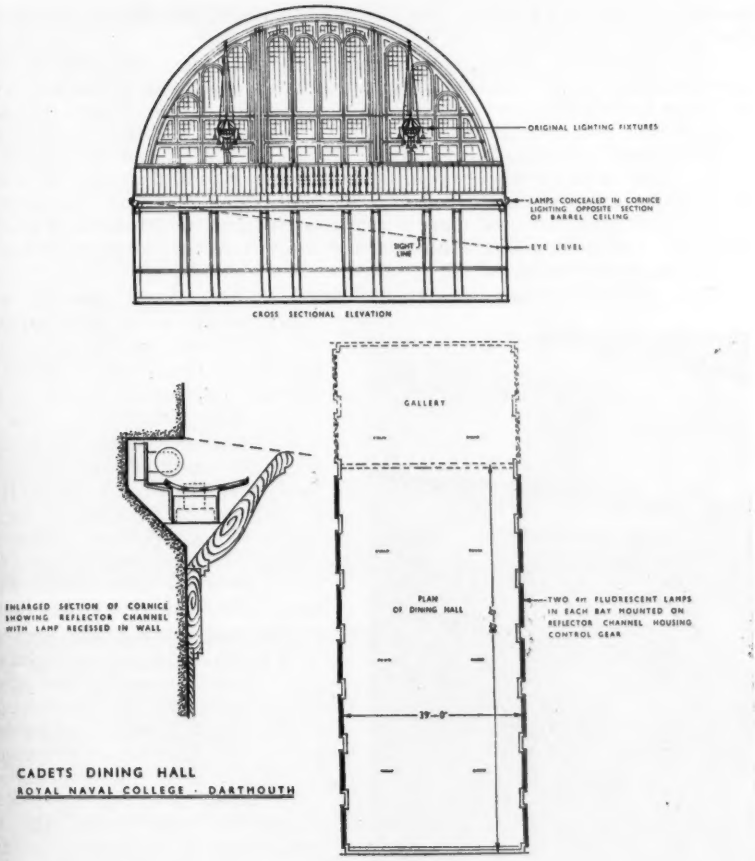
ORIGINAL LIGHTING FIXTURES
LAMPS CONCEALED IN CORNICE LIGHTING OPPOSITE SECTION OF BARREL CEILING
EYE LEVEL
SIGHT LINE
CROSS SECTIONAL ELEVATION
GALLERY
PLAN OF DINING HALL
TWO 4ft FLUORESCENT LAMPS IN EACH BAY MOUNTED ON REFLECTOR CHANNEL HOUSING CONTROL GEAR
39'-0"
ENLARGED SECTION OF CORNICE SHOWING REFLECTOR CHANNEL WITH LAMP RECESSED IN WALL
CADETS DINING HALL
ROYAL NAVAL COLLEGE · DARTMOUTH

Fig. 5.

fixed to the existing corona band by means of short brackets, and equipped with the necessary tungsten lamps to bring the illumination up to the required standard.

In another instance (Fig. 3) a fitting was required to provide two standards of illumination (1) for general lighting in the interior of the order of seven lumens per square foot, and (2) additional auxiliary lighting to increase the order of illumination to 14 lumens per square foot on a horizontal plane three feet above floor level.

The solution was based on the installation of decorative lanterns each arranged to take eight 4-ft. fluorescent lamps for general lighting, and one 300 or 500-watt tungsten lamp, the latter being on a separate circuit and mounted with a reflector in the bottom of the lantern. The half-sectional elevation of the lantern shows the constructional arrangement for the dispersal of the heat from the high-wattage tungsten lamp through the central cylindrical form of

the body, separated from the compartments housing the fluorescent lamps and control gear.

An example of the straightforward use of modern methods of lighting and equipment is provided by the main entrance showroom at Messrs. Waring's premises in Oxford Street (Fig. 4). In this instance it was necessary to provide illumination of a quality approximating to daylight in order to give proper colour values to the goods displayed. For aesthetic reasons the visual effect of the lighting fixtures was required in a warmer tone than that provided by daylight lamps. This combined effect was obtained by using vertical louvres of pink-tinted flashed opal glass between each lamp, which masked the lamps from the line of vision, but allowed the light from the lamps to fall directly on the goods displayed.

The practice of supplementing existing lighting from concealed sources is one which is mainly dependent on the architecture of the interior. The dining hall (Fig. 5) at the Royal Naval College, Dartmouth, provides an excellent opportunity for the application of this principle. The existing fittings are those originally installed in the room and are highly valued by the Principals of the College for their traditional associations. They were originally equipped with carbon lamps in small glass shades and are unsuitable for high-wattage lamps.

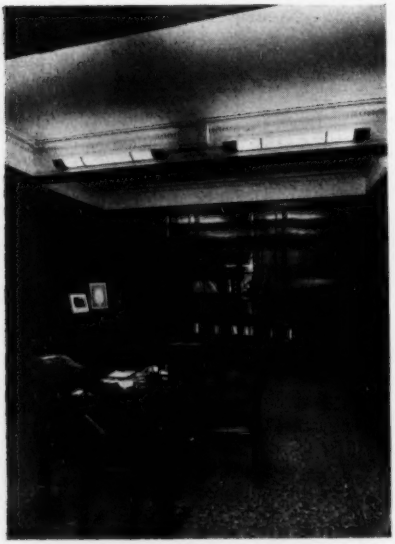

Fig. 6.

The barrel ceiling provides an ideal medium for indirect lighting and the cornice surmounting the panelling on the walls lends itself to the concealment of specially designed fluorescent lamp units. Experiments revealed the fact that with the lamps fixed on the wall surface, the light emitted upwards vertically above the lamps emphasised to an unwelcome degree the irregularities of the plaster ceiling. To overcome this objection it was agreed to cut a shallow channel in the walls to permit the lamps to be recessed behind the wall face and a specially designed reflector was incorporated to concentrate the light on the opposite half of the barrel ceiling. It was, however, proposed to retain the original fittings equipped with low wattage lamps so as to create the impression that they were the source of the illumination.

An instance of the method of applying externally a modern lighting unit to the existing structure of a room, is illustrated in Fig. 6. Glazed cornices containing 5 ft. fluorescent lamps are fixed on each side of the existing beams and the necessary control gear is housed in the box in the centre which was specially designed to harmonise with decorative treatment of the beams. (It should be stated, however, that these boxes could now be dispensed with by using the long type chokes and capacitors.)

The use of fluorescent lamps in groups is illustrated in Fig. 7 showing the lighting adopted in the Standard Bank of South Africa. With continuous cornice

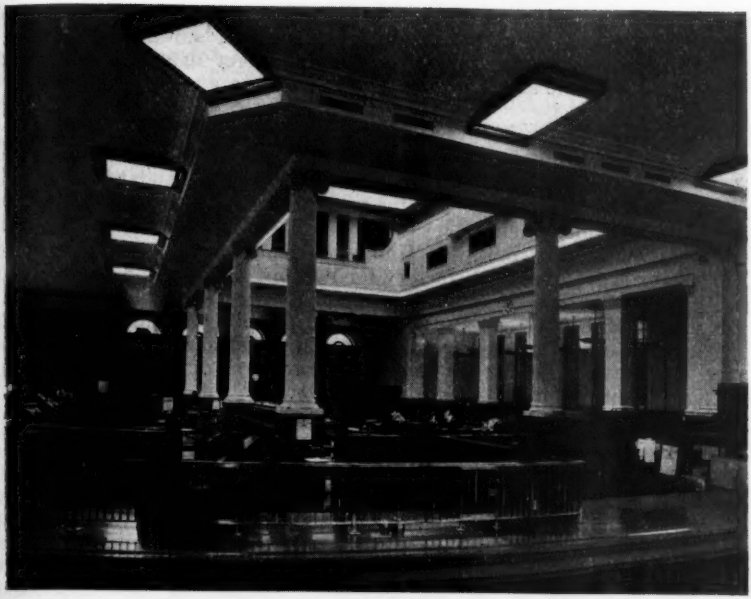

Fig. 7.

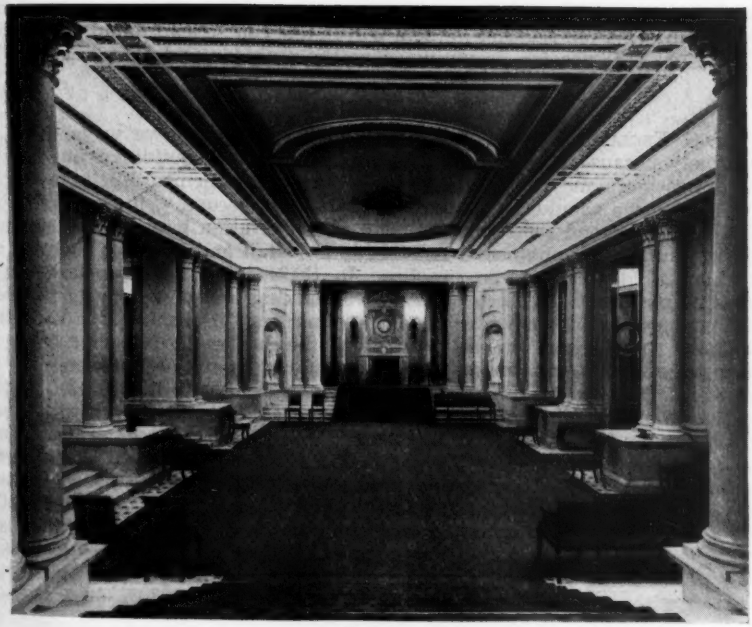

Fig. 8.

lighting round the light well it forms a pleasing and efficient system which would serve for the relighting of other interiors of similar character.

Fig. 8 shows an outstanding example of indirect lighting using striplite lamps concealed by the architrave moulding.

Domestic Lighting

The demand for fluorescent lamp fittings for private house lighting is ample evidence of the interest displayed in installing modern standards of illumination. Very few installations have so far been carried out owing to the limitation of supplies, but much preliminary work has been done in the preparation of suitable designs for this purpose. Unmasked lamps in plain white enamelled channels have proved very satisfactory for lighting kitchens and bathrooms, but in living rooms lamps masked with a diffusing screen are preferable.

Much care and ingenuity are necessary in the design of fluorescent fittings for private house lighting, one factor of special importance being ease of maintenance. At present their application is somewhat restricted owing to the sizes of the lamps being limited to 5 ft. and 4 ft. lengths, but when shorter lengths are available this form of lighting will be much more extensively applied.

CONCLUSION

The foregoing examples have been selected to give a general survey of the variety of lighting problems which are likely to be met under circumstances covered by the title of this paper. Yet they only touch the fringe of the subject. Some of them are theoretical, for the reason that existing conditions impose a limit to the possibilities of completing new installations. It is hoped that this indication of the direction in which ideas for the application of these new light sources are tending, and of the constructional details and technical information relating to them will in due course lead to more ambitious and original schemes for providing New Lighting for Old Buildings.

DISCUSSION

Dr. S. English said this was a very timely paper in two ways. First, it was timely because it dealt with the relighting of old buildings, and by the way things were moving at the present time, that seemed likely to be the only lighting we should do for several years; and, secondly, it was timely because it went beyond the familiar theme of co-operation between the architect and the illuminating engineer by giving some detail and showing how that co-operation could work out in practice. In these joint meetings, however, it always seemed that architects were shy of talking and of accepting the proffered co-operation. Architects need have no fear in asking help of the illuminating engineer. This reticence might be due to the fact that architects and engineers looked at things from very different points of view because of their very different training. The architect looked at illumination as the artist looked upon paint, i.e., a means of getting the finished picture which he had in his mind, but the illuminating engineer looked at it as a technical job and, as stated in the early part of the paper, had set up what he called standards. The architect might, with a certain degree of justification, say that these standards were wrong, since they do not give him the "picture" he aims at. On the other hand, the illuminating engineer might say that the architect had also set up ideals which were either impracticable or unsatisfactory in service. If the illuminating engineer designed for uniform lighting throughout an installation with a minimum of contrast or variation, the architect would prob-

ably say he did not want that because, in his view, it was only by the proper utilisation of contrast that the best results could be obtained.

Illustrating his point, Dr. English quoted two examples with which he was familiar. Some years ago, a world famous architect of a new cathedral wanted the altar and the beautifully carved woodwork behind it to form a picture in the eyes of the congregation. He wanted not uniform lighting but directional lighting to avoid "flatness," and also lighting of a higher intensity than elsewhere. This architect also insisted that in the choir stalls there should be no visible light source, and that there should be nothing bright between the congregation and the altar. That was done, and the result was remarkable; it produced a very beautiful effect which would impress anyone attending a service in that cathedral. If that problem had been given to an illuminating engineer without the dominating personality of the architect behind him, he would not have provided such a satisfactory solution, although he might have produced a more efficient one from the narrow technical point of view.

Another example from the other extreme was a small church of the early Norman period. Separating the nave from the choir was a Norman arch, and beyond the choir and the altar. The general lighting was provided by reflector fittings concealed behind the beams and well up in the roof. That general scheme was carried out from the nave to the choir and the altar, but in order to bring out the difference between the nave and choir and the altar, the reflectors in this altar section were fitted with pale amber colour screens, so that the altar and its furnishings stood out in a soft golden light which was quite distinct from the general lighting of the nave. Visitors to that little church agreed how beautiful the effect was, and here, again, non-uniformity was the keynote of success.

There was one particular point in the paper with which he was in very full agreement. The authors stated: "The functional uses of buildings vary as widely as their architectural characteristics, and the possible solution of the lighting problem is subject to like variations. It is seldom that identical methods can be adopted in two or more buildings; some modification is usually necessary to meet local requirements." In this connection, Dr. English recalled the following case. There was a small country village with the usual cross-roads. On one corner was the church, and on the other corner the "local," recently rebuilt. Both had the same lighting fittings and exactly the same system, but probably there were twice as many watts in the "pub" as there were in the church. He suggested that that was not quite right!

Mr. E. B. SAWYER, speaking on the question of colour values, said that years ago we had only the tungsten filament vacuum lamp, the light from which had a certain warmness. When that was superseded by the gas-filled lamp, objection was made to the coldness of the light, and it was quite common in churches to use straw-coloured screens. It might be of interest to note that, assuming an efficiency of 100 per cent. for the daylight fluorescent lamp, 580 per cent. was required with tungsten filament lamps to give the same colour rendering. Much the same comment applied to economy as mentioned in the paper—the figures were something of the order of 80 lumen hours per penny in 1921, and 800 lumen hours per 1d. to-day.; this takes into account the average cost of electricity and the price and improved efficiency of modern lamps. He thought economy was the wrong word in the statement that "Due economy is usually necessary in the interest of the owner." In his opinion it should read "Due attention to costs," as true economy was not necessarily a matter only of expenditure.

Under the heading Tungsten Filament Lamps, the paper stated that a

brightness of 5 candles per square inch may be acceptable for luminous surfaces within 20° above the horizontal at eye levels. He suggested that this was much too broad a statement and would usually result in discomfort glare; brightness of luminous surfaces cannot be divorced from surround brightness and various other factors.

In connection with fluorescent lamps, he emphasised the need for power factor correction, not for the operation of the lamp but from the point of view of the supply authorities. If the power factor was completely upset by large installations or large numbers of small installations, of fluorescent lamps without proper power factor correction, the economics of supply would be completely upset. He thought the authors rather over-emphasised what was only one of the problems with old buildings, namely, the presence of dark walls and brightness contrast. Here a combination of Direct and Indirect lighting would probably be better than either system separately. Old buildings usually had high ceilings, but in some it was hardly possible to walk across a room without bumping one's head on a beam.

Some of the illustrations in the paper might have been intended to show how good lighting had been substituted for bad, but in most cases he thought the illustrations indicated that there was room for collaboration between the lighting engineer and the architect in the preparation of a really suitable and pleasing lighting scheme.

Mr. ALISTER MACDONALD, F.R.I.B.A., said his mind was rather going round and round after what he had heard during the evening, but one thing was quite clear, that a great deal of time and care had been taken in the preparation of the paper and the demonstrations. The paper would serve a useful purpose even if it did no more than make everyone "think furiously," and so bring architects and illuminating engineers closer together. As a matter of fact, he had shuddered at most of the things he had seen that evening. At one time he would have shuddered at the thought of putting electric light bulbs into fittings that were originally designed for candles, but he now found himself preferring that to the straight lines of the fluorescent lamp and the chokes at either end. Indeed, he had been wondering whether this change of thought was due to his getting older and more old-fashioned in his ideas, but he did not think it was quite as bad as that. He believed that lighting was not something that was "applied" to a building; it was something that was part of a building and grew out of a building. Perhaps with these tubes and chokes the endeavour was being made to apply something rather than make it grow out of a building. The beautiful old candelabra in so many old buildings subsequently lit by gas and now by electric bulbs were, even if there might be a disposition to disagree with the details of the design, part of the building, and he did not see how it could be alleged that chokes and tubes were necessarily part of an old building. Such modern appliances could be part of an entirely different—i.e., modern—type of building. That, however, was not the subject of this discussion, which was concerned with new light in *old* buildings. Looking at the new types of lighting which had been demonstrated this evening, he was beginning to wonder whether they should not be kept for newly-designed buildings and not be applied to old and now historic buildings unless absolutely hidden from sight. We must not forget that the men who designed many of these old and historic buildings knew they were going to be looked at in semi-darkness anyway, and in endeavouring to improve the lighting of them he suggested that it was wrong to create uniformly bright diffused light all over the interior. The illuminating engineer could help the architect very consider-

ably in the use of reflected light in old rooms to produce the illumination required. Light was only required at certain spots by night and in the day-time also. Architectural effect and human appeal had been obtained by emphasising shadows as much as by creating light. In the lighting of old buildings, therefore, he hoped that the new types of fittings would be used as hidden powerful sources of light from which the light should be thrown on to the areas where it was wanted by means of built-in and screened reflectors, and not by means of visible tubes and chokes applied to walls and ceilings.

Mr. J. C. Lowson said that whilst he would like to endorse Mr. Macdonald's objection to the use of bare tubular lamps in architectural interiors, he felt it was a little harsh to say that the interiors of most old buildings should be viewed in semi-darkness. Anyone who had seen the lighting in the Royal Society building would appreciate that period architecture could be lit in a harmonious manner with fluorescent lamps, and new designs of control gear were making the concealment of the choke easier. He regretted the inexpert application of the tubular lamp in small shops without benefit of either architect or lighting engineer. Such installations were all too common and, being much in the public eye, were liable to give a false impression of the potentialities of fluorescent lighting.

Mr. W. E. Rawson-Bottom thought it might be opportune to point out that the Ministry of Works was responsible for a large number of most important buildings throughout the country, ranging from educational centres, museums and art galleries, to historic buildings like the Tower of London. They appreciated that each building presented a special study in itself; for each gave rise to different problems. At the same time, the Ministry kept itself abreast of modern developments, including developments in regard to lighting.

In old buildings, such as the Victoria and Albert Museum, there were hundreds of lighting points which might easily require to be moved and altered in order to accommodate the more modern system it was desired to install. This, however, would involve considerable expense, and would take years to accomplish. Nevertheless, so far as museums were concerned, the Ministry had installed some 270 fluorescent tubular lamps within the Kensington district alone, these installations being mainly of an experimental nature in order to obtain data and to observe the results and reactions before more general schemes were put into operation.

Regarding the lighting of one old building in particular, Mr. Rawson-Bottom mentioned the White Tower within the Tower of London, where there was housed an exhibition of old armour and ancient weapons. Here it was a question of obtaining a general illumination to enable the public to see both the details of the building and the exhibits, while remaining unaware of the lighting fittings. It was therefore decided to position fluorescent lamps behind the oak beams, and as the public was only allowed to pass through the galleries in one direction no one was conscious of the actual fittings, whilst the general diffusion enabled the exhibits to be seen quite comfortably. With this system of lighting there was unfortunately very little specular reflection, and the armour looked like new aluminium.

To conclude, the use of new lighting equipment designed for modern light sources, and having in mind purely architectural applications and the nature of the exhibits, was a subject of continuous experiment. To this end, the engineering division was working in close co-operation with architects in order

to achieve the desired results in buildings under the control of the Ministry of Works.

Mr. ANDERSON, replying on behalf of the authors, fully agreed with Dr. English that to produce certain effects non-uniform lighting was desirable. It was not intended that the paper should give the impression that effect lighting was discouraged.

In reply to Mr. Sawyer's remarks, it was agreed that true economy involved considerations wider than that of expenditure alone, and "due attention to costs" might well have been substituted in the context indicated. While admitting that some of the illustrations were open to criticism, they served to illustrate the details which were under discussion, and in several cases the lantern slides unfortunately did not do justice to the actual appearance of the original.

The authors were indebted to Mr. Alister Macdonald for expressing his reactions to the paper, and hoped that it would both stimulate thought on the subject and tend to a closer liaison between the architect and the illuminating engineer. While it was fully agreed that lighting at its best was something integral with a building rather than something which was applied to it, in practice one frequently had to compromise because the structural alterations involved and the cost of integral lighting were prohibitive.

It was stated in the paper that cold cathode fluorescent tubes could be applied in forms other than straight lines, and the associated gear could be situated remotely where desired. Illustrations of such installations had been shown on the screen. Installations of standard self-contained straight units were admittedly more numerous, because they were more easily installed and maintained. While the authors agreed with Mr. Macdonald that there were cases where straight lines of light were unsuitable, they hoped he would agree that there were other cases in which straight lines were appropriate. It was agreed that in other instances it was preferable to use these new light sources in such a way that they were concealed.

In conclusion the authors expressed their thanks to the R.I.B.A. for the excellent facilities which had been placed at their disposal and for the help they had received in arranging the demonstrations.

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

With a view to avoiding possible confusion with other publications, reference to these Transactions should be in the form :—"Trans. Illum. Eng. Soc. (London)."

Obituary

GEORGE HULBERT WILSON—1901-1946

It is with great regret that we announce the death of George Hulbert Wilson, B.Sc., A.M.I.E.E. (Fellow), which occurred on Sunday, November 17, 1946, in his forty-fifth year. He had been gravely ill for some time.

George Wilson will be mourned by illuminating engineers all over the country. He was one of the most popular members, with a lovable personality, a keen and kindly wit, and wide interests which he pursued with enthusiasm. He was an attractive lecturer and an ingenious demonstrator; his papers and lectures set a standard of presentation and interest seldom excelled, and he was penetrating and witty in discussion. His last contribution was in April last, when he discussed a paper by his colleagues at the joint meeting with the Science Masters' Association.

He was intended originally for commerce, but he found insurance irksome and took a degree in electrical engineering at Finsbury Technical College. He joined the research laboratories of the General Electric Company, Ltd., at Wembley, in 1922, when the Illumination Section was starting. He was appointed to the Leading Scientific Staff in 1924, and took over the responsibility of leading the section in 1929. He was mainly responsible for the leadership and building up of a team, and for the equipping of a laboratory which has made a great contribution to the art. When he began, illuminating engineering was in its infancy, and Wilson and the team under him worked out for themselves methods, techniques and instruments which have now become standard practice. He was one of the authors of the book, "The Theory and Design of Illuminating Engineering Equipment," written in 1930.

His personal contributions were considerable; but he will be remembered best as the personal friend of his colleagues and as the leader and inspirer of a team. He served the Society on many committees, was for many years an active member of the Council, and also shared in editing the Transactions of the Society. He was well known on British Standards Institution Committees and at the meetings of the International Illumination Commission from 1928 onwards, particularly for his interest in aviation lighting. He also acted as one of the examiners in illuminating engineering for the City and Guilds of London Institute.

With all his humour and enthusiasm, Wilson was a man of deep convictions and courage. He hated the idea of war, from the highest religious motives; and when it threatened, long before hostilities began, he decided to withdraw from any work connected with it. Eventually he left the laboratories of the General Electric Company, and after a period of relief work among air-raid victims, he became Physics master at the Lawrence Sherriff School, Rugby. Conscientious objectors are not popular in war-time; nevertheless Wilson was held in high esteem all over the country; and it was hoped that at the end of the war he would return to some branch of the profession in which he had made his name. But before it was over he became ill, and finally suffered the severe breakdown which led to his death. The sympathy of all his many friends will go to his mother and sister in their loss.

ANNUAL DINNER/DANCE

Arrangements have been made for a return to the pre-war practice of holding an annual dinner/dance, which this year will be held at the Grosvenor House, Park-lane, London, on Wednesday, May 14. It will be noted that this event will be preceded on May 13 by the Annual General Meeting, which is to be followed by an address by Dr. N. A. Halbertsma, President of the International Commission on Illumination. It is hoped that a good number of members from the local Centres and Groups will be able to be present at these two events. Full details of the dinner/dance will be issued shortly. Meantime it should be noted that attendance must unavoidably be restricted to a maximum of 400 persons.

BINDERS FOR TRANSACTIONS

A supply of spring binders for *Transactions*, similar in construction and appearance to those previously supplied, though of a size suitable for the present form of *Transactions*, is now available. Great difficulty has been experienced in getting materials for such binders and, though a limited supply has now been obtained, production costs are unavoidably higher than they were in pre-war years. Members will, however, no doubt be glad to avail themselves of the opportunity to bind their copies of the *Transactions* in this way and so preserve them in good condition. Binders will be supplied to members at the cost of 6s. 6d. each (7s. 6d. each to non-members).

Additions to List of Members

The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

SUSTAINING MEMBERS:—

Wallasey Corporation Electricity Dept.....*Representative*: Mr. F. F. Collieson. Electric House, Wallasey Road, WALLASEY.

CORPORATE MEMBERS:—

Allen, R. .....c/o G.E.C. (India), Ltd., Mount Road, Madras, S. INDIA.
Bourne, H. K. .....Research Laboratory, British Thomson-Houston Co., Ltd., RUGBY.
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The following application for Fellowship has been accepted:—

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